

November 30, 1886.

# ANNIVERSARY MEETING.

Professor STOKES, D.C.L., President, in the Chair.

The Report of the Auditors of the Treasurer's Accounts on the part of the Society was presented, by which it appears that the total receipts during the past year, including balances carried from the preceding year, amount to £7,226 8s. 9d., on the General Account, and £10,107 7s. 1d. on account of Trust Funds, and that the total expenditure in the same period, including purchase of stock, amounts to £5,363 12s. 11½d., on the General Account, and £6,911 16s. 6d., on account of Trust Funds, leaving a balance on the General Account of £1,838 5s. 10d. at the Bankers', and £24 9s. 11½d. in the hands of the Treasurer, and on account of Trust Funds a balance at the Bankers' of £3,195 10s. 7d.

The thanks of the Society were voted to the Treasurer and Auditors.

The Secretary then read the following Lists :—

Fellows deceased since the last Anniversary (Nov. 30, 1885).

## *On the Home List.*

Apjohn, James, M.D.	Fergusson, James, C.I.E., D.C.L.
Boileau, John Theophilus, Major-General, R.E., F.R.A.S.	Forster, Right Hon. William Edward.
Bunbury, Sir Charles James Fox, Bart., F.G.S.	Guthrie, Professor Frederick.
Busk, George, F.L.S.	Shadwell, Sir Charles Frederick
Cardwell, Edward, Viscount, F.G.S.	Alexander, Vice - Admiral, K.C.B.
Chapman, Thomas, F.S.A.	Solly, Edward, F.S.A.
Cobbold, T. Spencer, M.D.	Strafford, George Stevens Byng, Earl of.
Enniskillen, William Willoughby, Earl of, D.C.L.	Thomas, Edward, C.I.E., F.S.A.
Evans, Sir Frederick J. Owen, K.C.B., R.N.	Waveney, Robert Alexander Shafto Adair, Lord.

## *Withdrawn.*

Bouverie, Right Hon. Edward Pleydell.

Fellows elected since the last Anniversary.

Bidwell, Shelford, M.A.	Russell, Henry Chamberlaine, B.A.
Colenso, William, F.L.S.	Sedgwick, Adam, M.A.
Dixon, Harold B., F.C.S.	Thurlow, Right Hon. Thomas John Hovell - Thurlow Cumming-Bruce, Lord.
Festing, Edward Robert, Major-General, R.E.	Unwin, Professor W. Cawthorne, B.Sc.
Forsyth, Andrew Russell, M.A.	Warrington, Robert, F.C.S.
Green, Professor A. H., M.A.	Wharton, William James Lloyd, Captain R.N.
Horsley, Prof. Victor, F.R.C.S.	Wilde, Henry.
Meldola, Raphael, F.R.A.S.	
Pye-Smith, Philip H., M.D.	
Rosebery, Right Hon. Archibald Philip Primrose, Earl of.	

*On the Foreign List.*

Baeyer, Adolf.	Kowalewski, A.
Klein, Felix.	Lovén, Sven.

The President then addressed the Society as follows:—

For many years it has been my duty as senior Secretary to read at each Anniversary the death-roll of the year. The names this year are perhaps slightly fewer than usual, but many recall to us faces once familiar that we shall never see here again. Earliest among them comes Sir Frederick Evans, whose death took place only very shortly after our last Anniversary. In the course of the preceding summer he crossed the Atlantic to take part in that International Conference which assembled at Washington, to deliberate among other things on the choice of a common prime meridian for all civilised nations. On his return he was looking ill, and the illness increased until it carried him away. Yet even through his illness he kept on working at science, at a task he had undertaken, and which was almost completed when he died. To this I shall have occasion to refer again. In Mr. Busk we have lost one whose detailed knowledge of certain branches of natural history and comparative anatomy was almost unrivalled. He took an active part in the scientific business of the Society, and repeatedly served on our Council, and both then and subsequently gave us the benefit of his extensive knowledge and sound judgment in the important but laborious task of reporting on papers. In Lord Cardwell we have lost a statesman whose political duties did not prevent him from coming among us and serving on our Council. The public services and singular honesty and straightforwardness of Mr. Forster are appreciated by the nation at large. Quite recently, at no advanced age,

we have lost Professor Guthrie, the occupant of a chair which a great many years ago I held for a time; a man whose genial character drew around him a close circle of friends. Still more recently we have lost the Earl of Enniskillen, whose fine palæontological collections are well known to geologists. Only the other day one passed away whom we seldom missed at our anniversary meeting, and who was frequently with us on other occasions: I allude to General Boileau, whose philanthropic labours will not soon be forgotten, and may, I trust, be recognised in a much needed form.

The Fellows will have noticed with satisfaction a very considerable excess of income over expenditure in the balance sheet for the year. At first sight it might be supposed that as the 'Transactions' come out at irregular intervals there might have been fewer parts published than usual; but it will be found on examination that the past year has borne its proper share of printing expenses. The excess is really due to a substantial improvement in the Society's property, under the careful and judicious management of our Treasurer.

Last year our President informed the Fellows of the munificent offer made to the Society by Sir William Armstrong to give to the Scientific Relief Fund the sum of 6,500*l.*, provided an equal sum were raised within a year by subscription from the Fellows, and if need be, other friends of science who might not belong to the Society. As the Fellows are aware, a circular was sent round by the Treasurer mentioning Sir William Armstrong's generous offer, and inviting subscriptions; and the Treasurer has also written privately to a number of persons, Fellows, and others. The sum subscribed or promised in response to this invitation amounts to about 4,200*l.*; and though the sum thus raised does not amount to what Sir William promised to duplicate if it could be raised, he has most generously not only waived the non-fulfilment of the condition subject to which the former offer was made, but has still further augmented it; and he now promises not only to duplicate the sum raised in answer to the Treasurer's appeal, but to give the further sum of 3,600*l.*, thus raising the capital from the present sum of about 8,000*l.* to 20,000*l.* He will be ready to pay the whole sum of 7,800*l.* as soon as the subscriptions promised to the Treasurer have been collected. The only condition attached to this princely gift is, that besides meeting the ordinary objects for which the Fund was instituted, the Council should feel themselves at liberty to apply a portion of the income towards the remission of fees in cases of urgent necessity.

The path of the total eclipse of the 9th of September last year, in any place where it fell on land, was so remote from this country that no expedition went out to observe it. It was visible in New Zealand, and in anticipation of it our Eclipse Committee sent out a memorandum to the Colony indicating the points of special interest to look

out for. We have received accounts, drawings, and photographs of the eclipse from Dr. Hector and others. One of the most remarkable features of this particular eclipse was the appearance of two white and unusually bright prominences which attracted general notice, and were compared to electric lamps, and which, situated on opposite sides of the sun, were just over the places of two large spots, one close to the limb, and on the point of disappearing, the other not seen before the eclipse but visible next day, having in the meantime come round the limb.

The present year afforded another of those rather rare occasions, always of brief duration, which are afforded for the study of solar physics by a total eclipse of the sun. Calculations made long beforehand showed that a total eclipse was to be expected on the 29th of August. The path of the total phase on the earth's surface is always narrow, say 100 miles or so across, and on this occasion it swept obliquely across the Atlantic Ocean, cutting the Western Coast of Africa about Benguela, and sweeping across some of the West India Islands to a part of the mainland of South America, where it ended.

Though there was a long belt of ocean over which the totality would be visible, and where the imposing spectacle of a total eclipse might be witnessed, this was not available for regular scientific observations, which require land on which to fix the instruments. On the mainland of America the total phase would come on so shortly after sunrise that the sun would be too low for good observations, and therefore the Island of Grenada, which lay within the belt of totality, was much to be preferred.

Of the two available stations, one lay in the British dominions, and was pretty easy of access from England, and accordingly it seemed to be the duty of our country to take a foremost place in the observations, the results of which would be available to the whole scientific world. It was contemplated first to send expeditions to both places—to Benguela as well as Grenada. The cost of this would, however, exceed what could be spared from the Government Grant without unduly curtailing what was available for other objects. Accordingly application was made to the Lords of the Treasury for a grant of 1,000*l.* towards the cost of the expeditions. Enquiries were also made as to the probable climate at the two places; and here I have to express our thanks to the Governor-General of the Windward Islands, who put us in communication with Dr. Wells of Grenada, from whom we obtained valuable information regarding the climate of that island, and to the Consul-General for Portugal, who obtained information for us from the Polytechnic Institution at Lisbon as to the amount of sunshine about the end of August at Loanda, which may be taken pretty well as representing Benguela.

The information we obtained from various sources as to Benguela

was rather conflicting, but there seemed a pretty general agreement that even if the sun should be shining at the time of the eclipse the sky was likely to be hazy. This would much interfere with good observations, especially as regards the corona; and as the expense of the expedition to Benguela would be considerable, and the success very doubtful, we thought it better to give up that part of the project and confine ourselves to Grenada. Being anxious to trench as little as possible on the national expenditure, and finding that a little more could be taken from the Government Grant than we had expected, we wrote to the Treasury reducing our application to 500*l.*, which with assistance from the Admiralty in the shape of the use of a ship-of-war on the West Indian station, and supplemented by some money from the Government Grant and from our own Donation Fund, might enable us to meet the expenditure.

The result was that a sum not exceeding 500*l.*, to supplement what could be spared from the Government Grant, was granted, and the expedition, as the Fellows are aware, has sailed and returned. It was fairly successful, the observations having been prevented by clouds at only one of the stations occupied.

There has not yet been time to discuss the observations in full, but two points already appear to have come out pretty clearly. One is that the brightness of the corona, which on this occasion was actually measured, was much less than had been expected, and less apparently than it had been on former occasions. This seems to show that the brightness is liable to great changes when we compare different years, as we know is the case with the form. The other point touches on the question of the possibility of photographing the corona independently of an eclipse. If the photographic brightness of the corona be not overpowered by that of the atmospheric glare immediately around the sun when there is no eclipse, then when the sun is partially eclipsed we might expect to be able to trace the outline of the limb of the moon for some way outside the sun, since the moon would be projected on the background of the corona. The experiment was tried both by Captain Darwin at Grenada, and by Dr. Gill at the Cape, but in neither case was the limb traceable outside the sun. This throws doubt on, but does not disprove, the validity of the method proposed by Dr. Huggins; for he himself has never obtained photographic appearances apparently referable to the corona since the Krakatoa eruption. It may be that the finely suspended particles, whether connected with the Krakatoa eruption or not, which produced those gorgeous sunsets that were so remarkable, have not yet wholly subsided, and cause a considerably increased atmospheric glare. It may be that the corona has actually been much less bright than usual for the last few years.

The present year has been signalised by that remarkable volcanic

explosion in New Zealand, of which we have read accounts in the newspapers. We have received from Dr. Hector a series of photographs of the district, taken at no great length of time after the explosion.

The Krakatoa Committee, which was appointed at the suggestion of our late President to collect information relative to the great eruption, have now I may say completed their work. The Royal Meteorological Society had appointed a Committee to get together information respecting the remarkable atmospheric phenomena witnessed after the eruption. It was thought desirable that the two Committees should work in concert, and accordingly our Committee was enlarged by the addition of two members of the Royal Meteorological Society, even though they did not happen to be members of the Royal Society, who undertook that share of the work. The information collected under this head is naturally voluminous, since it requires no special training to describe the atmospheric appearances. Our late Fellow Sir Frederick Evans undertook the sea disturbance, and continued to work at it even in an advanced stage of the disease which carried him off. Another fortnight, it was estimated, would have enabled him to complete it. His account was found to have been written in pencil on separate sheets of note paper, but his successor in the office of hydrographer, Captain Wharton, our Fellow, was so good as to take up the work; and partly by the use of materials left by Sir F. Evans, partly by his own independent labour, he has now completed it. The report on air disturbance was undertaken by General Strachey, and is ready. Professor Judd undertook the geological part; the materials are ready, and though the actual report is not yet written, the writing would take but very little time. Mr. Scott undertook to collect information as to floating pumice; but as it has been found that the Krakatoa pumice does not possess distinctive features whereby it could be recognised, and therefore the origin of the pumice that ships have encountered at a distance from Krakatoa remains unknown, little trustworthy information could be obtained under this head, and the report has been handed over to Professor Judd to embody with the geology. The heaviest part of the report, that relating to sunsets and atmospheric phenomena, has been prepared by the Hon. Rollo Russell and Professor Archibald, the two Fellows of the Royal Meteorological Society who have been mentioned as having been added to the Committee, and is ready, with the exception of a little revision, and it remains only to prepare an introduction, index, &c. The whole report may therefore be regarded as all but complete in manuscript, and it will be for the new Council to deal with it.

The Circumpolar Committee have now brought their labours to a close, the report on the observations taken by Captain Dawson

at Fort Rae being printed and published. The reports of the expeditions undertaken by Austria, Germany, and the United States of America, are, I believe, complete, and those by France, Holland, and Russia are in a forward state. Before the accounts of the observations taken at different stations by the observers of different nations shall have been for some time before the public, it would be premature to expect general conclusions to be deduced from this great undertaking.

Very satisfactory progress has been made during the past year with the publication of the Report of the "Challenger" Expedition. The volumes already published and in the Society's Library now amount to sixteen on Zoology, and three introductory on other subjects. Others are in a very forward state, and it is expected that the whole will be published very nearly within the time mentioned by the Committee, probably by the end of the next financial year.

As mentioned in the Presidential Address last year, advantage has been taken of the British occupation of Egypt to make some explorations by way of boring in the Delta of the Nile, to the results of which geologists attach great importance. The War Department has allowed some of the staff of the Royal Engineers, when their services were not otherwise required, to take part in the operations, and has lent the boring apparatus, and the Royal Society voted the sum of 350*l.* out of its own Donation Fund to defray the cost of labour and other incidental expenses. It was contemplated originally to make a chain of borings, but the depth to which it has been found necessary to proceed in order to get through the ordinary deposit has turned out to be so great that it was thought better, instead of attempting many, to try and get if possible down to rock, or to something else which might afford evidence that what could be referred to alluvium from the Nile or drifted sand had really been got through. A deep boring has accordingly been made at Zagazig, under the direction of Captain Dickenson, R.E. This has now been carried to a depth of 190 feet 6 inches below the surface, or 164 feet 5 inches below the mean sea-level at Alexandria, and yet nothing has been reached but sand and clay with small pebbles. Professor Judd is now engaged in the examination of the matter brought up. A derangement of the boring apparatus prevented for the present further progress, and the use of a narrower pipe than any at hand would be required for carrying the boring deeper. The Committee considered that it would be more important to extend this boring, so as if possible to get down to rock, or else to some deposit with fossils, than to make a fresh boring in a different place, and arrangements are being made accordingly. The inquiry was deemed a proper one to be assisted out of the Government Grant, and the sum of 200*l.* has been voted from this source to supplement the Royal Society's grant already mentioned.

The ordinary meetings of the Society are well known, and are frequently attended by strangers by permission of the Fellows present; and the papers brought before us are known to the world through our publications. But a great deal of scientific work is done of which the outside public know nothing. There have been thirteen meetings of the Council during the year, and the attendance at our Council meetings is remarkably good. There have been more than seventy meetings of Committees and Sub-Committees. There is further another task on which a great deal of gratuitous and conscientious labour of the highest kind is bestowed, I allude to the examination of papers with a view to advising the Committee of Papers as to their publication. The past year has shown no flagging in scientific activity, in relation to papers brought before us.

Since the last Anniversary three parts of the 'Philosophical Transactions,' comprising upwards of 1160 pages of letterpress and 95 plates, and eight numbers of the 'Proceedings,' containing 1299 pages, have been published.

The preparation of the manuscript for another decade, 1874 to 1883, of the Royal Society's catalogue of scientific papers, is now almost complete. This great work has been extremely useful to men of science in enabling them at once to find where a memoir on a particular subject, written by an author whose name they know, as is usually the case, is to be found. To some extent it enables them also to find what has been written on a particular subject, for there are usually one or two authors, whose names they know, who have made it a special study, and on consulting their papers references are frequently found to the writings of others who have written on the same subject. Nevertheless it must be confessed that the value of the catalogue would be greatly increased if it could be accompanied by a key, of the nature of an *index rerum*. It was originally contemplated that this should be added, but the magnitude of the undertaking has hitherto prevented the Committee from attempting it. To be well done it would require the long-continued labour of a scientific staff representing different branches of science, and they could not be expected to engage in so heavy a work without adequate remuneration.

A great deal of work has been done during the past year in relation to the Library. More than 5,000 volumes have been removed to other rooms to make space for the more important works constantly accruing. A list of duplicates and deficiencies has been printed, and circulated among corresponding Societies. A shelf-catalogue is in progress, and is about a third of the way towards completion. Some work has also been done upon a catalogue of miscellaneous literature.

The electric lighting of the Society's apartments, which is now complete, seems to have given general satisfaction.

On the 31st of August this year, our distinguished Foreign Member,



M. Chevreul, attained his hundredth year. Rarely indeed is it given to anyone to see right through a century, more rarely still to retain his powers to such an age, yet both, I am happy to say, have been granted to M. Chevreul. In anticipation of this event, preparations were made for its due celebration. I received an invitation for our Fellows to assist at the celebration; but unfortunately it was at a time of year when most of us were scattered, and moreover time did not permit of making it generally known. I am afraid we had no representative at the actual ceremonial, but I am sure that none the less our hearts were with the veteran savant.

This year has also witnessed the celebration of the 250th anniversary of the University of Heidelberg. The Council had appointed our Foreign Secretary as a deputation to represent the Society on the occasion. Unfortunately when the time was close at hand, Dr. Williamson was prevented by the condition of his health from taking part in the celebration; but acting on the emergency on behalf of the Society, I requested our Fellow, Sir Henry Roscoe, to take his place, which he was so good as to do.

In his Presidential Address last year Professor Huxley suggested the idea, I may say expressed the hope, that the Royal Society might associate itself in some special way with all English-speaking men of science; that it might recognise their work in other ways than those afforded by the rare opportunities of election to our foreign membership, or the award of those medals which are open to persons of all nationalities alike. This suggestion has been taken up in one of our Colonies. We have received a letter from the Royal Society of Victoria, referring to this passage in the Address, and expressing a hope that in some way means might be found for establishing some kind of connexion between our own oldest scientific Society and those of the Colonies.

The Council have appointed a Committee to take this letter into consideration, and try if they could devise some suitable plan for carrying out the object sought. The Committee endeavoured at first to frame a scheme which should not be confined to the Colonies and Dependencies of the British Empire, but should embrace all English-speaking communities. But closely connected as we are with the United States by blood and language, they are of course politically a foreign nation, and this fact threw difficulties in the way of framing at once a more extended scheme, so that the Committee confined themselves to the Colonies and Dependencies of our own country, leaving the wider object for some future endeavour, should the country concerned seem to desire it. The scheme suggested was laid before the members of the present Council, but there was not an adequate opportunity of discussing it, and it will of course come before the new Council. Should they approve of some such measures

as those recommended by the Committee, they will doubtless assure themselves in some way or other that those measures are in accordance with the wishes of the Fellows at large before they are incorporated into the Statutes.

But in connexion with this subject there is another suggestion which I would venture to offer, and which I know has been thought of by others.

A good many years ago it was not unusual to elect to the Fellowship men of distinguished eminence in departments other than scientific. More recently a change was made in the Statutes whereby Privy Councillors are enabled to become Fellows by a special method, without interfering with the selection by the Council of fifteen from among the candidates, whom they recommend to the Society for election. This to a certain extent superseded the necessity of appealing to other than scientific claims, and in some respects the method had special advantages. Those who attained to a place on Her Majesty's Privy Council were sure to be distinguished men, whom we should be glad to welcome among us; and by confining the privilege of special election to these, with whose appointment the Council had nothing to do, all invidious distinctions were prevented. But the method has the disadvantage that it applies only to a particular class of merit. A man, for instance, might be of quite first rate eminence in poetry or literature, but that would not lead to a seat on the Privy Council. Such a man could only be elected by being placed on the selected list of fifteen. But it seems to me that there is something not quite courteous either to the eminent man himself, or to the scientific man who would have to be passed over to make room for him, in thus putting him in competition with those who seek admission on purely scientific grounds. I cannot help thinking that it might be well if the Council had the power of recommending for special election men of high distinction on other than scientific grounds, whose connexion with us would on both sides be felt to be an honour, and who, though not it may be themselves scientific, might usefully assist us by their counsel. I do not think it would be difficult to devise means for providing that such a privilege should be accorded only in case of very high eminence.

The application of photography to the delineation of celestial objects has of late years made rapid strides; and, partly owing to the improved sensitiveness of the plates, partly to greater exactness in regulating the motions of equatorially mounted telescopes, it has been found possible to photograph even minute stars. The question is accordingly now seriously entertained whether we may not trust to photography for the formation of star maps and star catalogues, taking eye observations on a sufficient number of stars here and there for reference, and trusting to differential measurements taken on the

plates for determining the positions of the other stars. Indeed I think the practicability of this application may now be considered as established, and there only remains the question of the best mode of carrying it out on a uniform plan. In the course of the autumn I had a letter from Admiral Mouchez, Director of the Paris Observatory, in which he informed me that in response to the presentation of specimens of the admirable star photographs taken by the MM. Henry, several of the astronomers to whom they had been sent suggested that it would be well that a conference of astronomers of various nations should be held, with a view to taking concerted action for obtaining on a uniform plan a complete map of the whole starry heavens. He wished accordingly to obtain an expression of opinion on the part of the Royal Society as to the desirableness of holding such a conference; and as it was contemplated, in case the proposal should be favourably entertained by those consulted, that the conference should be held at Paris in the spring, and it would be necessary to give timely notice to the astronomers who live in the southern hemisphere, an early reply was requested.

As it would have defeated Admiral Mouchez's object to wait till the Council should reassemble after the recess, I wrote at once to consult four of our Fellows specially named by Admiral Mouchez; and on receiving their replies I wrote to Admiral Mouchez, saying that under the circumstances I took it upon me to express in the name of the Royal Society our approval of the suggestion, explaining at the same time that I did so on the understanding, which I fully believed, to be in accordance with his intention, that the astronomers who might attend the conference should not be considered as pledged to the adoption of the methods or scale of the MM. Henry, but that the whole subject should be open to discussion. On reporting what I had done to the Council when they met after the recess, I obtained an expression of their approval.

In these photographs a remarkable instance was exhibited of the power of photography to reveal the existence of objects wholly invisible to the eye. One of the stars of the Pleiades was found to be surrounded by a nebula which cannot be seen with telescopes. The reason of the difference of power of the plate and eye is very obvious; with the eye an object is either seen or not seen at once, whereas with the plate, provided there be an absence of stray light, feebleness of intensity can be made up for by length of exposure.

But the MM. Henry are by no means the only persons who have applied photography to the delineation of the stars. Among others our Fellow, Dr. Gill, who has sent us some excellent specimens of the photographs obtained by his instrument, proposes to take at the Cape Observatory photographs of the whole starry heavens of the southern hemisphere, under such conditions as to include the magnitudes

contained in Argelander's "Durchmusterung" of the northern hemisphere, and to subsequently reduce the observations so as to complete Argelander's great work by extending it to the southern hemisphere. Professor Kapteyn, in Holland, has nobly undertaken to devote his spare time for seven years to superintending the reduction. Dr. Gill has laid the proposal before the Government Grant Committee. Having regard to the magnitude of the undertaking, and the probability of a conference of astronomers being shortly held in Paris to discuss the whole question, the Government Grant Committee suggested to the Council of the Royal Society that they should appoint a committee to take the subject into consideration, and the Council have acted on this suggestion. Dr. Gill intends to come to Europe in the spring, so that the committee will be able to consult him personally.

This morning I received through the Foreign Office an invitation from the Académie des Sciences for myself, or some other Delegate of the Royal Society, to attend the conference to which I have already referred, which is fixed for the 16th of April. I shall take the first opportunity of consulting the new Council as to their wishes.

The Copley Medal for this year has been awarded to the veteran in science, our foreign member, Professor Franz Ernst Neumann, for his researches in theoretical optics and electro-dynamics.

Having in his earlier years treated of crystallographic subjects, he more than half-a-century ago turned his attention to the theory of light. Fresnel had, with his wonderful sagacity, arrived at his celebrated laws of double refraction from the theory of transverse vibrations, aided by conceptions derived from a dynamical theory which was only in part rigorous. Cauchy and Neumann, independently of each other, were the first to deduce from a rigorous dynamical calculation, applied to a particular hypothesis as to the constitution of the ether, laws of double refraction, not indeed absolutely identical with those of Fresnel, but closely resembling them. In this case the laws were known beforehand. But in a very elaborate later paper, Professor Neumann deduced from theory the laws of crystalline reflection, laws which appear to agree with the observations of Seebeck, and which had not been discovered by Fresnel, though some of them were independently and about simultaneously obtained by MacCullagh.

Professor Neumann is perhaps still better known in connexion with the theory of electrodynamics, and the mathematical deduction of the laws of induced currents due to the motion of the primary and secondary conductor. He may be said to have completed for the induction of currents the mathematical treatment which Ampère had applied to their mechanical action.

Of the two Royal Medals, it is the usual, though not invariable,

practice to award one for the mathematical and physical, and the other for the biological sciences.

One of these medals has this year been awarded to Professor Peter Guthrie Tait, for his various mathematical and physical researches.

Professor Tait is well known for his numerous and important papers in both pure mathematics and physics. The late Sir William Hamilton regarded him as his own successor in carrying on and completing the newly invented calculus of quaternions, of which Professor Tait is continually making new applications. Among his investigations in the domain of experimental physics may be mentioned his determination of the conducting powers of metals for heat by a method which appears to possess special advantages, and his investigation of the effect of extremely great pressures on thermometers, undertaken with a view to deducing correct results for the temperatures at great depths in the ocean from the observations made in the "Challenger" expedition. This latter subject has led him to investigate the behaviour, as to compressibility and development of heat, of liquids and solids under enormous pressures, a subject in which he is still engaged. Before concluding I must mention his elaborate papers on systems of knots, recently printed in the Transactions of the Royal Society of Edinburgh.

The other Royal Medal has been awarded to our Fellow, Mr. Francis Galton, for his statistical inquiries into biological phenomena.

Mr. Galton is well known as an explorer and geographer, and his mind is singularly fertile in the devising of ingenious instruments for various objects. Many years ago he brought before us some remarkable experiments instituted with a view to test a particular biological theory, in which rabbits of a pure variety were so connected with others of a different variety that the same blood circulated through both individuals, and the point to determine was whether this blood-relationship, in the most literal sense of the term, had any effect on the offspring. Contrary to what the theory in question led us to regard as the more probable, the result proved to be negative. It is, however, in accordance with the rules for the award of the Royal Medals, more especially the later investigations of Mr. Galton, in relation to vital statistics, that have been taken as the ground of the award. He has shown that by taking the average of a number of individuals having some condition in common, individual peculiarities apart from that condition are eliminated in the mean, and results are obtained which may be regarded as typical of that condition. One way of doing this is by his method of compound photographs. Thus we may obtain typical features of criminals of a particular kind, of consumptive persons, and so forth. By adhering to the method of averages, he has even succeeded in obtaining a mathematical expression, very closely verified by observation, con-

necting the mean deviation of some condition (such for example as stature) in a series of individuals from the general average with the mean deviations of the same condition in the relatives of those same individuals of different kinds, such as fathers, brothers, &c. Nor is the statistical method applicable to bodily characteristics alone. Mr. Galton has even extended it with remarkable ingenuity and originality to mental phenomena also.

The Rumford Medal has been awarded to Professor Samuel P. Langley, for his researches on the spectrum by means of the bolometer.

A better knowledge of the ultra-red region of the spectrum, which includes the larger part of the energy of solar radiation, had long been a desideratum, when Professor Langley commenced his work upon this subject. Finding the thermopile insufficiently sensitive for his purpose, he contrived the "bolometer." This instrument depends upon the effect of temperature upon the electrical resistance of metals, a quantity susceptible of very accurate measurement; and, with its aid, Professor Langley has been able to explore a part of the spectrum previously almost inaccessible to observation.

A result of Professor Langley's work, very important from the point of view of optical theory and of the ultimate constitution of matter, relates to the law of dispersion, or the dependence of refrangibility on wave-length. Cauchy's formula, which corresponds well with observation over most of the visible spectrum, is found to break down entirely when applied to the extreme ultra-red.

Professor Langley has given much attention to the important question of the influence of the atmosphere on solar radiation. The expedition to Mount Whitney, successfully conducted by him in face of many difficulties, has given results of the utmost value, pointing to conclusions of great interest and novelty.

The Davy Medal has been awarded to our foreign member, M. Jean Charles Galissard de Marignac, for his researches on atomic weights.

M. Marignac's numerous researches on atomic weights, which have been continued for a great number of years, have played an exceedingly important part in establishing and consolidating that groundwork of chemistry. They are remarkable for originality in devising methods appropriate to the respective cases, the most conscientious care in discovering errors which occurred in the respective operations, and indefatigable perseverance in finding means to eliminate the disturbing influences. His labours are all the more valuable because he chose for their field chiefly those elements which are most generally used in chemistry, and are most important to chemists, and on which the determination of new atomic weights is most generally made to depend.

The Statutes relating to the election of Council and Officers were then read, and Sir Erasmus Ommaney and Mr. Stainton having been, with the consent of the Society, nominated Scrutators, the votes of the Fellows present were taken, and the following were declared duly elected as Council and Officers for the ensuing year:—

*President.*—Professor George Gabriel Stokes, M.A., D.C.L., LL.D.

*Treasurer.*—John Evans, D.C.L., LL.D.

*Secretaries.*—{ Professor Michael Foster, M.A., M.D.  
The Lord Rayleigh, M.A., D.C.L.

*Foreign Secretary.*—Professor Alexander William Williamson, LL.D.

*Other Members of the Council.*

Professor Robert B. Clifton, M.A.; Professor George Howard Darwin, M.A., LL.D.; W. T. Thiselton Dyer, M.A.; Professor David Ferrier, M.A.; Edward Frankland, D.C.L.; Arthur Gamgee, M.D.; Archibald Geikie, LL.D.; Professor Joseph Henry Gilbert, M.A.; John Hopkinson, M.A., D.Sc.; J. Norman Lockyer, F.R.A.S.; Sir Lyon Playfair, K.C.B., LL.D.; Professor Bartholomew Price, M.A.; Professor Pritchard, M.A.; Admiral Sir George Henry Richards, K.C.B.; Professor Arthur Schuster, Ph.D.; Philip Lutley Sclater, M.A.

The thanks of the Society were given to the Scrutators.

The following Table shows the progress and present state of the Society with respect to the number of Fellows:—

	Patron and Royal.	Foreign.	Com- pounders.	£4 yearly.	£3 yearly.	Total.
Nov. 30, 1885 ..	5	45	196	182	87	515
Since Elected ..		+ 4	+ 3	+ 1	+ 13	+ 21
Since Withdrawn				— 1		— 1
Since Deceased ..			— 7	— 10		— 17
Nov. 30, 1886 ..	5	49	192	172	100	518

## Balance Sheet, 1886.

## Statement of Receipts and Expenditure from November 14, 1885, to November 13, 1886.

	£	s.	d.		£	s.	d.
To Balance at bank, 14th November, 1885	£1,183	1	3	By Salaries, Wages, and Pension	1,469	16	0
Less Trust Funds (see below)	717	12	8	" Catalogue of Scientific Papers	187	9	0
" Balance in hand, Catalogue Account	17	9	7	" Books for the Library	254	1	5
" " " " " " " " " " " "	14	17	5	" Printing and Advertising Transactions, and Separate Copies to Authors and Publisher	368	12	7
" Annual Contributions, 175 at £4.....	700	0	0	" Ditto Proceedings, Nos. 239 to 245.....	735	15	3
" " " " " " " " " " " "	300	0	0	" Ditto Miscellaneous	62	2	6
" Admission Fees.....	20	0	0	" Paper for Transactions and Proceedings	418	7	10
" Compositions.....	180	0	0	" Binding ditto	50	0	0
" Fee Reduction Fund, in lieu of Admission Fees and Annual Contributions	250	0	0	" Engraving and Lithography	1,037	5	9
" Rents:				" Soirée and Reception Expenses	101	15	5
Fee Farm, Lewes	18	11	2	" Coal, Lighting, &c.	55	10	0½
Mablethorpe Estate	92	16	11	" Office Expenses	125	2	4½
" Ground Rents	673	0	10	" House Expenses	20	16	11½
" Dividends (exclusive of Trust Funds)	2,525	7	2	" Tea Expenses	56	15	0
do. Jodrell Fund	150	5	10	" Fire Insurance	61	15	3
" Interest on Mortgage Loan	580	0	0	" Taxes	18	19	0
" Sale of Transactions and Proceedings	1,218	6	5	" Advertising	94	11	3
" Balance of Naturalists' Account	20	4	10	" Postage (including Scientific Relief Circulars), Parcels, and Petty Charges	30	17	9
				" Miscellaneous Expenses	37	19	10
				" Law Charges	78	7	10
				" Eclipse Expedition, Cash advanced (making with previous advances £131 3s. 1d. due)	24	9	11½
				" Balance on hand, Catalogue Account	13	9	7
				" Ditto, Petty Cash	11	0	4½
				" Balance at Bankers'	1,838	5	10
					£7,226	8	9





### *Estates and Property of the Royal Society, including Trust Funds.*

Estate at Mablethorpe, Lincolnshire (55A. 2R. 2P.), rent £110 per annum.  
 Ground Rent of House No. 57, Basinghall Street, rent £380 per annum.  
 " " of 23 houses in Wharton Road, West Kensington, rents £253 per annum.  
 Fee Farm Rent, near Lewes, Sussex, £19 4s. per annum.  
 One-fifth of the clear rent of an estate at Lambeth Hill, from the College of Physicians, about £52 per annum,  
 Croonian Lecture Fund.  
 Stevenson Bequest. Chancery Dividend. One-fourth annual interest on Government Annuities and Bank Stock  
 (produced £534 19s. 9d. in 1885-86).  
 £21,000 Reduced 3 per Cent. Annuities { £14,952 12s. 3d., General Purposes.  
 £15,000 Mortgage Loan, 4 per Cent. { £6,047 7s. 9d., Handley Fund.

{ being £15,861 19s. 1d., namely :—	
	£ s. d.
Donation Fund .....	6,389 0 1
Rumford Fund .....	2,322 19 0
Wintringham Fund .....	1,200 0 0
Gassiot Trust .....	200 0 0
Sir J. Copley Fund .....	1,666 13 4
General Purposes ....	4,133 6 8
and £3,452 1s. 1d. in Chancery, arising from sale of the Coleman Street Estate.—General Purposes.	
£403 9s. 8d. New 2½ per Cent. Stock.—Bakerian and Copley Medal Fund.	
{ £7,000, Scientific Relief Fund.	
{ £12,182 14s. 10d. New Threes	
{ 5,182 14s. 10d., Jodrell Fund.	

*Estates and Property of the Royal Society—continued.*

£667 5s. 6d. India Fours.

£600 Midland 4 % Debenture Stock.—Keeck Bequest.

£5,660 Madras Railway Guaranteed 5 per Cent. Stock { General Purposes, £5,000,  
£10,000 Italian Irrigation Bonds.—The Gassiot Trust. { Davy Medal Fund, £660.

£3,796 Great Northern Railway 4 per Cent. Debentures { Scientific Relief Fund, £2,400,  
£4,000 Metropolitan 3½ per Cent. Stock.—Fee Reduction Fund. { The Trevelyan Bequest, £1,396.

£27,000 London and North Western Railway 4 per Cent. Perpetual Debenture Stock.—Fee Reduction Fund.

£5,000 North Eastern Railway 4 % Preference Stock.—General Purposes.

£5,000 London and North Western Consolidated 4 % Preference Stock.—General Purposes.

£2,000 South Eastern Railway 4% Debenture Stock.—Darwin Memorial Fund.

We, the Auditors of the Treasurer's Accounts on the part of  
the Council, have examined these Accounts and found them correct.

G. G. STOKES.  
BARTHOLOMEW PRICE.  
ARCHIBALD GEIKIE.  
W. J. RUSSELL.

We, the Auditors of the Treasurer's Accounts on the part of  
the Society, have examined these Accounts and found them correct.

T. G. BONNEY.  
JOHN RAE.  
JAMES COCKLE.  
H. T. STANTON.

## Trust Funds. 1886.

## Scientific Relief Fund.

<i>Dr.</i>			<i>Cr.</i>		
	£	s. d.		£	s. d.
New 3 per Cent. Annuities .....	7,000	0 0	By Grants .....	299	0 0
Great Northern 4 per cent. Debenture Stock .....	2,400	0 0	" Purchase of £1,000 Great Northern Railway	1,222	9 0
Uninvested .....	1,332	5 0	" 4 per cent. Debenture Stock .....	846	19 11
			" Purchase of £844 17s. 7d. New 3 per Cents. ....	1,365	10 5
			" Balance uninvested.....£1,332 5 0 }		
			"     " in hand ..... 33 5 5 }		
				<u>£3,733</u>	<u>19 4</u>
To Balance { Uninvested .....	83	11 3			
{ In hand .....	60	6 3			
Dividends .....	93	17 6			
" Bentham Bequest.....	271	19 2			
" Donations .....	67	11 2			
	3,300	11 6			
	<u>£3,733</u>	<u>19 4</u>			

## Donation Fund.

	£	s. d.		£	s. d.
The Trevelyan Bequest. £6,339 0s. 1d. Consols.			By Grants .....	414	10 0
£1,396 Great Northern Railway 4 per Cent. Debenture Stock.			" Dividend credited in error last year .....	7	14 8
			" Balance .....	417	16 3
				<u>£840</u>	<u>0 11</u>
To Balance .....	426	16 5			
" Dividends .....	237	17 0			
" Transferred from Handley Fund .....	175	7 6			
	<u>£840</u>	<u>0 11</u>			

*Rumford Fund.*

£2,322 19s. Consols.

	£	s.	d.
To Balance .....	67	10	4
" Dividends, 1886 .....	67	7	8
	£134	17	7

By Balance .....

£134 17 7

*Bakerian and Copley Medal Fund.*

Sir Joseph Copley's Gift, £1,666 13s. 4d. Consols.

£403 9s. 8d. New 2½ per Cent. Stock.

	£	s.	d.
To Balance .....	108	7	1
" Dividends, New 2½ per Cent. Stock .....	9	15	0
" Dividend—Sir J. Copley's Fund .....	48	6	6
	£166	8	7

By Gold Medal .....

£ 4 10 7

" Prof. Kekulé, Sir J. Copley's Gift .....

50 0 0

" Lectures, 1885 and 1886 .....

10 7 6

" Balance .....

101 10 6

£166 8 7

*The Keck Bequest.*

£600 Midland Railway 4 per Cent. Debenture Stock.

To Dividends, 1886 .....	£	s.	d.
	23	4	0
<hr/>			
By Payment to Foreign Secretary .....	£	s.	d.
	23	4	0

By Payment to Foreign Secretary .....

23 4 0

*Wintringham Fund.*

£1,200 Consols.

	£	s.	d.
To Balance .....	34	17	6
" Dividends, 1886 .....	34	15	10
	£69	1	4

By Payment to Foundling Hospital, 1886 .....

£ 34 17 6

" Balance .....

34 15 10

£69 13 4

*Croonian Lecture Fund.*

One-fifth of the clear rent of an Estate at Lambeth Hill, from the College of Physicians, about £52 per annum.

	£	s.	d.
To Balance .....	5	15	3
" Rent .....	46	13	8
	<hr/>		
	£52	8	11
	<hr/>		
	£	s.	d.
By Poor of St. James's, per Rev. J. E. Kempe .....	2	18	9
" Law Expenses .....	9	17	0
" Dr. L. C. Woodbridge, Lecture .....	39	13	2
	<hr/>		
	£52	8	11
	<hr/>		

*Davy Medal Fund.*

£660 Madras Guaranteed 5 per Cent. Railway Stock.

	£	s.	d.
To Balance .....	74	6	1
" Dividends .....	35	8	7
	<hr/>		
	£109	14	8
	<hr/>		
	£	s.	d.
By Gold Medals .....	32	6	0
" Balance .....	77	8	8
	<hr/>		
	£109	14	8
	<hr/>		

*The Gassiot Trust.*

£10,000 Italian Irrigation Bonds,

£200 3 per Cent. Consols.

	£	s.	d.
To Balance .....	167	13	5
„ Dividends .....	495	13	7
	<hr/>		
	£663	7	0
	<hr/>		
	£	s.	d.
By Payments to Kew Committee .....	489	17	7
„ Balance .....	173	9	5
	<hr/>		
	£663	7	0
	<hr/>		



*Darwin Memorial Fund.*

£2,000 South Eastern Railway 4 per Cent. Debenture Stock.

	£	s.	d.		£	s.	d.
To Balance .....	368	5	2	By Printing .....	7	9	6
" Dividends, 1886 .....	77	6	8	" Balance .....	438	2	4
	£445 11 10				£445 11 10		

## ADMINISTRATIVE FUND.

*Circumpolar Expedition Fund.*

	£	s.	d.		£	s.	d.
To Balance .....	587	11	5	By Expenses .....	167	4	8
	£587 11 5			" Balance .....	420	6	9
	£587 11 5				£587 11 5		



Account of the appropriation of the sum of £4,000 (the Government Grant) annually voted by Parliament to the Royal Society, to be employed in aiding the advancement of Science (continued from Vol. XXXIX, p. 310).

1885-86.

	£
Dr. D. Gill, for continuing the daily photographs of the Corona, and Star-charts of the Southern Hemisphere by direct photography .....	300
H. B. Dixon, for apparatus and assistance in experimenting on the Explosion of Gases .....	100
H. Tomlinson, for apparatus used in an investigation of the Influence of Stress and Strain on the Physical Properties of Matter .....	50
Prof. W. N. Hartley, for assistance and appliances to be used in continuing Researches on the Application of Spectrum-photography to Quantitative Chemical Analysis .....	100
Prof. C. Lapworth, for aiding in collecting and studying the Graptolites of Wales and the West of England. ....	50
Dr. Wooldridge, for a research on the Physiology and Pathology of Blood .....	35
F. Gotch, for investigation of the physiological Properties and anatomical Structure of the electrical organ of <i>Malapterurus electricus</i> .....	75
A Committee of the Royal Irish Academy, for Dredging operations off the S.W. Coast of Ireland .....	100
Dr. W. R. Dunstan, for investigation of the physiological Properties of the glucoside Loganin which occurs in <i>Strychnos nux-vomica</i> .....	75
Dr. F. R. Japp, for an investigation of the reactions of Ketones, Diketones, and allied compounds .....	75
Prof. Humpidge, for apparatus to continue a Research on the Specific Heats of the Solid Elements in the pure state and at varying temperatures .....	50
Prof. Humpidge, for his Research on Metallic Glucinum. ....	12
W. E. Adeney, for completion of the work of determining the Wave-lengths and Mapping the Lines of the Ultra-violet Spark-spectra of Nickel, Cobalt, Palladium, Gold, and Platinum .....	50
The Scottish Meteorological Society, for an investigation on Sea-temperature, and a discussion of observations from 1855 to present time .....	50
Carried forward. ....	£1,122

Brought forward.....	£1,122
W. Doberck, for aid in making sufficient Observations to construct Hygrometric Tables for use with Rotating Thermometers.....	100
W. W. Haldane Gee, for determining certain Magnetic Constants of Iron, Nickel, and Cobalt, and their alloys; especially to investigate the temperature coefficients of magnets made from the materials .....	25
Dr. D. Gill, for constructing an improved apparatus for Photographing Star Maps .....	100
W. F. Denning, for observation of Shooting Stars, and of their radiant points, with special reference to the long duration and stationary position of many meteor showers .....	40
G. J. Symons, for studying the Barometric Oscillations of short period which occur only during thunderstorms .....	22
G. J. Symons, for renewing Rain-gauges on certain mountains in the English Lake District, and in Wales .....	30
J. H. Poynting, for the determination of the Mean Density of the Earth by the ordinary balance .....	40
The Eclipse Committee of the Royal Society, towards the expenses of the Eclipse (1886) Expedition .....	400
The Pendulum Committee of the Royal Society, for the expense of Pendulum Observations to be made at the Kew Observatory .....	150
G. R. Vine, for further work upon and descriptions of British Fossil Polyzoa and other organisms .....	20
S. J. Hickson, for the hire of boats and labour in the pursuit of work upon the Anatomy and Development of Millepora, &c. ....	100
H. T. Stainton, in aid of publication fund of the Zoological Record Association.....	100
J. Starkie Gardner, for concluding investigations into the Fossil Floras of the Basaltic Formations of Ireland and Scotland .....	50
The Liverpool Marine Biology Committee, for the exploration of the Sea Bottom by Dredgings in Liverpool Bay and the neighbourhood .....	25
W. C. McIntosh, for continuation of Researches on the ova and development of the Food and other Fishes, and on the reproduction of the Common Mussel .....	100
Percy F. Kendall, for the exploration by excavation and the removal to Manchester of a large quantity of the Clay of the recently discovered Pliocene deposit of St. Erth, Cornwall	30
Carried forward.....	£2,454

Brought forward.....	£2,454
W. Bateson, for an investigation of the Fauna of the fresh-water and salt Lakes of the Steppes lying to the North of the Sea of Aral.....	200
Rev. A. E. Eaton, for cost of illustrations of Terrestrial Isopod Crustacea .....	100
J. T. Cunningham, for continuing a Research on the Development of Marine Teleostean Fishes, and of <i>Myxine glutinosa</i> .....	100
Dr. P. F. Frankland, for apparatus and chemicals to be used in his investigations on the Micro-organisms in Air and Water .....	20
Spencer Pickering, for further investigations on Molecular Compounds .....	100
Prof. W. K. Parker, for continuation of Researches into the Morphology of the Vertebrata.....	300
Prof. T. Rupert Jones, for examination and description of the Fossil Entomostraca (Ostracoda) .....	100
	<u>£3,374</u>

Dr.

	£	s.	d.
To Grant from Treasury .....	4,000	0	0
To Repayment.....	47	6	3
To Interest on Deposit.....	3	12	0
	<u>£4,050</u>	<u>18</u>	<u>3</u>

Cr.

	£	s.	d.
By Balance over-drawn, Nov. 30, 1885	301	12	5
By Appropriations, as above.....	3,374	0	0
Printing, Postage, Advertising, and other Administrative Expenses .....	95	10	6
By Balance on hand, Nov. 30, 1886 ....	279	15	4
	<u>£4,050</u>	<u>18</u>	<u>3</u>

## Account of Grants from the Donation Fund in 1885-86.

	£	s.	d.
Mr. W. W. Watts, for a research on the Petrology of the Volcanic Rocks of Corndon .....	15	0	0
Mr. Norman Collie, for a research on the action of Hydrochloric Acid, and Haloid compounds of Hydrocarbon radicles, on the Amide of Acetoacetic Ethyl Ether	15	0	0
Dr. Cash, for an inquiry on Intestinal Movements ....	15	0	0
Dr. Gaskell, to assist in his researches on the relation of the cranial to the spinal Nerves, and on the anatomy of the visceral Nerves.....	30	0	0
Prof. Schäfer and Mr. J. R. Bradford, for a research upon the electrical conditions of secreting Glands .....	25	0	0
Rev. S. J. Perry and Prof. Balfour Stewart, to assist in their comparison of the Magnetograph Curves of Kew and Stonyhurst .....	30	0	0
Captain Abney, for the expenses of the Bakerian Lecture.....	2	0	0
Mr. Crookes, for aid in his researches on Yttria .....	50	0	0
Prof. Rupert Jones, for illustrations of the Fossil Entomostraca (Ostracoda).....	25	0	0
Dr. McMunn, for purchase of a Microspectroscope with a view to further examination of the Spectra of the organs and tissues of animals .....	12	10	0
Dr. Cash, for a pharmacological investigation into the action of some of the Aromatic Compounds which have not as yet been examined .....	20	0	0
Mr. G. J. Symons, towards the cost of Thermometric Observations on the tower of Lincoln Minster .....	20	0	0
Mr. Sherrington, for aid to pursue in Italy the researches on Cholera, in which he was engaged in Spain in conjunction with Prof. Roy .....	100	0	0
Mr. Warren de la Rue, for the completing of his Catalogue of Latitudes and Longitudes of Solar Spots, £200.			
On account..	55	0	0
	<u>£414</u>	<u>10</u>	<u>0</u>